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ABSTRACT

System Implications of Multi-Modular Nuclear Power Plants

Principle Investigator (U.S.): Richard Wood
Oak Ridge National Laboratory

Principal Investigator (Brazil): Antonio C. Barroso
Instituto de Pesquisas Energeticas e Nuclearares (IPEN)

Collaborators: Westinghouse Electric Company, Electronuclear

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Small reactors of modest power (150-350 MWe) are attractive for international near-term deployment (INTD) because of anticipated features such as flexibility for staged deployment, limited up front financial investment, and suitability for co-generation. Modularity for these small reactors has been identified as a significant factor that could result in potential capital cost savings. However, before these economic benefits can be realized, the system engineering implications of modularity for design, construction, commissioning, and operation of a multiunit plant must be evaluated. The objective of this project is to address this challenge by investigating the prospective approaches to implementation and management of a multi-modular nuclear plant so that technical issues can be identified and resolved.

The technical elements to be considered for a multi-modular strategy include determination of shared systems/resources (e.g., plant process and auxiliary systems, instrumentation and control systems, and control room resources such as space, human-system interfaces, information systems, and personnel) and supervisory control of a multi-modular plant with selectable energy products (e.g., reconfigurable balance of plant systems for electrical generation and desalination). The investigation of shared systems/resources involves assessment of the suitability of resources for sharing and evaluation of the impact of common systems (e.g., risk, performance, reliability, cost).

The outcome of this investigation is expected to be insight into practical approaches for sharing systems/ resources and the foundation for an evaluation methodology derived from a specific prototypic application for a selected modular INTD reactor design. The investigation of multi-modular plant management and supervisory control addresses strategies for coordinated use of shared systems and managed transitions among plant configurations (e.g., phased commissioning of units or flexible system arrangements for selection among co-generation options). These strategies include supervisory control approaches for managing demand allocation, system reconfiguration, and energy product transition. The outcome of this investigation is expected to be demonstration of strategies and methods that facilitate optimized use of the flexible characteristics of modular small reactors.

The small modular reactor design to be used in this proposed project will be the IRIS reactor since all participating organizations are members of the IRIS Consortium. However, the results will be general and applicable to other small modular reactor concepts (e.g., PBMR).